AD-A278 709

TATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 1994	3rd Annual Technical Report (11/15/91-11/14/92)

4. TITLE AND SUBTITLE
"Absolute, Extreme-Ultraviolet Solar Spectral Irradiance Monitor (AESSIM)"

5. FUNDING NUMBERS
AFOSR-90-0063 2310/~~A2~~ BS
61102F

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8. PERFORMING ORGANIZATION REPORT NUMBER
N/A
AFOSR-TR- 94 0254

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AFOSR/~~NC~~ NL
Bolling AFB
Washington, DC 20332-6448
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10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AFOSR-90-0063

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Several AESSIM mission concepts which involve spectrometers on rocket underflights and those on the *Voyager* spacecraft have been considered.

We have studied a low-pressure version of the EUV radiance standard of Hollandt, Huber & Kühne (Appl. Opt. **33**, 68, 1994) and concluded that a substantial redesign of it would be required if a suitable one is to be developed for in-orbit calibration of a solar spectral irradiance monitor.

We have reviewed the use, suitability, and the availability of thin film filters for in-orbit EUV calibration. In our opinion, the availability of space-qualified filters has not been verified.

We have evaluated and chosen a design of a 4-spectrograph, flat-field package that provides 0.1 to 0.2 nm resolution in the range 5-175 nm with a total weight including detectors (without electronics) of 1.6 Kg.

14. SUBJECT TERMS	15. NUMBER OF PAGES
solar, extreme-ultraviolet, radiometric calibration	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
unclassified	unclassified	unclassified	ul (unlimited)

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Sesquicentennial Year 1989

THIRD ANNUAL TECHNICAL REPORT: Grant AFOSR-90-0063

Absolute, Extreme-Ultraviolet Solar Spectral Irradiance Monitor (AESSIM)

prepared and submitted by

W. H. Parkinson & Peter L. Smith,

March 1994.

The goal of the Absolute, Extreme-Ultraviolet Solar Spectral Irradiance Monitor (*AESSIM*) project is development of a method for establishing and maintaining the radiometric accuracy of instrumentation for daily solar spectral irradiance measurements at extreme-ultraviolet (EUV) wavelengths. In-orbit radiometric recalibration is a fundamental requirement for such measurements.

We proposed: (1), to investigate, design, and test a smaller and less massive, low-power, in-space version of a 'standard' EUV radiance source, which has been developed for laboratory use; (2), to assess, in collaboration with Dr. G. Schmidtke, the merits of innovative combinations of rare-gas ionization cells and thin film filters to make absolute measurements of EUV radiation over a number of wavelength bands; (3) to evaluate flat field spectrograph designs that could use array detectors; and (4), to outline a proposed solar EUV monitoring mission.

AFOSR-90-0063 funds were originally awarded for the period 11/15/89 - 11/14/92; a 12-month, no-cost extension brought the period of performance to 11/14/93.

LABORATORY ACTIVITIES

Our studies of the low-power version of the EUV radiance standard of Hollandt, Huber & Kühne [Appl. Opt. 33, 68, 1994] showed that the lamp was stable but not reproducible to the accuracy required, which is about $\pm 5\%$. Hollandt and colleagues (private communication) believe that the low current of the low-power version is not sufficient to maintain the clean, unoxidized, cathode surface that is required for reproducibility. We therefore have concluded that drastic redesign of the low power version of the hollow cathode radiance standard will be required if a suitable version is to be developed for in-space use.

We discussed with Dr. G. Schmidtke [Fraunhofer Institute, Freiburg, Germany] the use of rare-gas ionization cells and thin film filters for absolute measurements of solar EUV radiation over a number of broad wavelength bands. In our opinion, the availability of a

variety of space-qualified thin film filters that could be used to define a number of distinct wavelength bands has not been verified. Therefore, we chose not to include these components in an *AESSIM* concept called *ASSET* (Absolute Solar Spectrum in the EUV for *TIMED*) that was proposed for the NASA *TIMED* (Thermosphere, Ionosphere, Mesosphere Energy and Dynamics) mission. Schmidtke chose to join a competing team and our collaboration with him was terminated to avoid conflict of interest. [Neither proposal was accepted.]

A number of small, flat-field spectrograph concepts were evaluated. We chose one of Sandel & Broadfoot (Optical Engineering **32**, 3112, 1993) and designed a 4-spectrograph package that provides 0.1 to 0.2 nm resolution over the range 5 to 175 nm. The compact size permits four spectra (which overlap to provide redundancy) to be detected by two array detectors. Total mass, including detectors but not electronics, is estimated to be 1.6 kg.

Mass and power requirements for several AESSIM mission concepts employing rocket underflights and an innovative use of the *Voyager* spacecraft for radiometric calibration were developed.

PRESENTATIONS & PUBLICATIONS

Concepts for regular, radiometrically accurate solar EUV spectral irradiance measurements were presented at two meetings: (1), *The Fourth Meeting on New Developments and Applications in Optical Radiometry*, held in Baltimore in October, 1992, and (2), *The Ninth Workshop on the Vacuum Ultraviolet Calibration of Space Instruments*, held at HAO/NCAR in Boulder, CO, March, 1993. The proceedings of (1) are published in Metrologia:

- *Using The Voyager Spacecraft for Solar EUV Spectral Radiometry*, P. L. Smith, B. R. Sandel & J. B. Holberg. Metrologia, **30**, 397-401 (1993).
- *SOURCE: The Solar Ultraviolet Radiation and Correlative Emissions Mission*, P. L. Smith, J. L. Lean, A. B. Christensen, K. L. Harvey, D. L. Judge, R. L. Moore, M. R. Torr & T. N. Woods. Metrologia, **30**, 275-277 (1993).

Similar contributions with the same titles are found in the proceedings of (2), which were edited by T. N. Woods and published by HAO/NCAR.

WORK IN PROGRESS

The final report for AFOSR-90-0063 will be prepared and submitted by 5/15/94.